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COMPARATIVE EFFICACY OF THREE SYNTHETIC IGRS (BRUCE, RUNNER AND FALCON) ON THE DEVELOPMENT OF *TROGODERMA GRANARIUM* (EVERTS) (COLEOPTERA: DERMESTIDAE)

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In the present research three IGR's viz bruce , Falcon and Runner with different concentrations 0.03, 0.06 and 0.09 were tested against *Trogoderma granarium* under laboratory conditions.. Different dilutions of IGRs were prepared using distilled water and were applied on grains which were air dried before insect release. Twenty grubs (7 days old) were allowed to feed treated grains and data were recorded for larval mortality, larval weight, pupal and adult emergence. On overall basis at larval stage pyriproxifen gave best results, causing mean mortality 7.08% followed by Methoxyfenazide (Runner) with mean value 5.83% while Tebufenazide (Falcon) caused minimum mortality 3.33% at maximum concentration 0.09 ppm. Mortality and concentration showsed positive correlation while mortality and interval showed negative correlation. All the three IGR's showed good impact on the reduction of larval weight. Pyriproxifen (Bruce) caused 32.49% t larval weight reduction over control with mean value 4.27 (unit ?) followed by methoxyfenazide (Runner) which gave 29.82% larval weight reduction followed by control mean value 4.73. Tebufenazide (Falcon) gave minimum 26.40% larval weight reduction over control with mean value 2.61 (unit ?). Similarly, regarding pupal development, , pyriproxifen gave highest percent pupal reduction over control 75.26% with mean value 5.34 while Tebufenazide gave minimum pupal percent reduction over control 63.22% with mean value 6.64.

Keywords: Mortality, *T. granarium*, growth inhibition, Runner, Bruce, Falcon, larval weight

INTRODUCTION

Stored grain pests cause post-harvest losses up to 9% in developed countries and up to 20% losses in developing countries (Phillips and Thorne, 2010). Insect pest cause losses in terms of quality and quantity of food commodities and changes the chemical composition affecting the nutritive value of the products (Swaminathan, 1977). These insect pests have been damaging our economy by infesting agricultural stored products.These are responsible for worldwide loss of 10-40% in the stored grain annually (Mathews, 1993). Among different insect pests of stored grains, *Trogoderma granarium* are the most important and a damaging pest of wheat grains. Severe invasion of cereals sources by khapra beetle can make the commodity unpleasant, hard to digest or unremarkable (Reference ?). It is predicted that an invasion point of 75% injured grains in wheat plus a few further cereals sources a substantial decrease in whole protein and carbohydrates well as further straight and tortuous harm to grain (Jood and Kapoor, 1993; Jood *et al*., 1996).

Continuous use of synthetic pesticides for protecting stored grain commodities possess remarkable drawbacks including worldwide development of insecticide resistant strains, (Chaudhry, 1997; Bell, 2000; Benhalima *et al*., 2004) handling hazards, concerns about insecticide residues on grains (Norman , 2000) and threat to human health and the environment. Public consciousness of these risks has increased interest in finding alternative stored-product protectants to replace synthetic chemical insecticide (Silver, 1994). One such alternative is the use of insect growth regulators that are highly effective against several pests of store grain commodities because they tend to have low mammalian toxicity, little environmental effects and wide public acceptance (Kostyukovskyet al. 2000; Mondal and Parween, 2001; Ishaayaet al., 2007).

Among insect growth regulators, chitin synthesis inhibitors (CSIs) have been found to be more efficient at killing all immature stages of a broad range of insect species, including the internal grain feeders, Elek and Longstaff (1994); Elek (1998a); Elek (1998b); Daglish and Wallbank (2005).

MATERIALS AND METHODS

The preliminary study has been conducted in the grain Research, Training and storage management Cell of the Department of Agri. Entomology, University of Agriculture, Faisalabad during the year 2010-2011.

Collection of insects: Heterogenous samples of adults of *Trogoderma granarium* were collected from the farmer grain godown of Bahawalpur.-

Rearing of insects: The insects culture was maintained in sterilized jars placed in the laboratory at 30±2˚C and 70± 5% R.H in 24 hours dark period to get the homogenous population.

The culture medium (wheat grains) was sterilized at 70˚C for an hour and then thoroughly washed with tap water to remove dust and other insect pest After that , grains were air dried under upto level of 13-14% moisture content.
The jars were covered with muslin cloth, tied with rubber bands to avoid the escape of beetles. The insect culture was maintained in different sterilized jars filled with gm grain for continuation of culture. Larvae (5-7 days old) were used in the experiment.

IGR: Runner (Methoxyfenazide, 240 SC), Falcon (Tebufenazide 25% WP) and Bruce (Pyriproxifen 10.8% EC) were tested at (0.03, 0.06 and 0.09 ppm) concentrations which were prepared in water and were applied on grains which were air dried before release of insects.
Bioassay: For bioassay twenty (seven days old) larvae of *T. granarium* were placed into 250ml jars containing 20gm of treated grains with 0.03, 0.06 and 0.09 ppm concentration of Bruce, Runner, and Falcon and an untreated control. Larval mortality, larval percent, pupation, adult emergence, oviposition and egg hatching were recorded Population build of test insects has been studied in a separate experiment by removing surviving insects after one week feeding on treated grain in order to determine the latent effect of IGR treatment if any.

Statistical analysis: Data of larval mortality was corrected by Abbott's formula (Abbott, 1925) and was analyzed statistically by using software Statistix 8.1 (Analytical software, 2003). The significant results were compared using Tuckey's HSD test.

RESULTS

Comparison of mean values of data regarding percent mortality of *T. granarium* under different concentrations X all IGRs. The results given in the table (1) showed that the mean percent mortality of different IGRs at different concentrations.
Pyriproxifen showed maximum mortality (7.08%) at highest concentration (0.09ppm) followed by 5.83 and 3.33 was found in Methoxyfenazide and Tebufenazide, respectively. While minimum mortality (2.91, 1.66 and 1.66%) was recorded at lowest concentration (0.03ppm) against Pyriproxifen, Methoxyfenazide and Tebufenazide respectively.

Larval weight reduction: The data given in the table (3) showed the mean values of loss in larval weight in different concentration of Pyriproxifen, Methoxyfenazide and Tebufenazide, which differ significantly from one another.
Maximum reduction over control in larval weight 32.49% was found in Pyriproxifen followed by 29.82% and 26.40% in Methoxyfenazide and Tebufenazide respectively.

Pupal emergence: The results given in the table (4) showed that mean values of pupation in different concentrations of Pyriproxifen, Methoxyfenazide and Tebufenazide which show statistically significant results. Maximum reduction in pupal weight 75.26 was recorded in Pyriproxifen followed by 67.17 and 63.22 in Methoxyfenazide and Tebufenazide respectively.

population reduction for all IGRs vs Concentration: In the present table (4) data showed the population reduction for all IGRs at different concentrations. The overall result shows that maximum population reduction (77.92) was found in pyriproxifen at highest concentration followed by Methoxyfenazide and Tebufenazide showed population reduction 62.22 and 59.79, respectively. While minimum population reduction was found in Tebufenazide (39.82 at lowest concentration (0.03), respectively.

DISCUSSION

In the present research effect of three IGRs (Bruce, Falcon and Runner) have been tested against *Trogoderma granarium* on wheat treated with three concentrations (0.03, 0.06 and 0.09ppm) of selected IGRs. The data regarding mortality were recorded after 24, 48, 72 and 96 hours. The results indicate that mortality of *T. granarium* increases with the increase in concentration of insect growth regulators.
On an average Pyriproxifen gives maximum mortality of 6.66% followed by 5.83% and 4.58% in case of Methoxyphenazide and Tebufenazide at highest concentration (0.09 ppm),respectively. Nayak *et al.* (2005) found that an application of 1ppm of spinosad cause 50% mortality of adults on produced wheat. Larval weight loss of *T. granarium* under the different treatments of pyriproxifen gave the best result.
The maximum reduction in larval weight was found in Pyriproxifen which was 32.48 followed by 29.82 and 26.40 in Methoxyfenazide and Tebufenazide respectively. The similar result was also reported by Kostyukovsky *et al. (*2000) which explained that extension of exposure of juvenoids and ecdysteroids led to the production of giant larvae. The results are also agreement with those of Stamopoulos et al. (2007) who have reported that food intake was lower as expected, therefore the weight decreased.Pupation of *T. granarium* was drastically affected by pyriproxifen treatment.
The maximum % reduction was 75.26 % followed by 67.179% and 63.22% in Methoxyfenazide and Tebufenazide respectively. The contrary results of Isaaya *et al.* (2003) showed that dietary ZR-512 and ZR-619 induced prolongation of larval feeding period upto tenfold.
The induced prolongation of the larval stage after juvenile hormone treatment was followed by pronounced of cuticle phenoloxidase activity, indicating an alternation of the larval biochemical process and J.H treatment inhibits pupation and emergence.
Begum and Huda (1974) reported that latent effect of triflumuron and diflubenzuron reduces the survivability rate at pupal stages. Maximum % population reduction mean was found in pyiproxifen (77.92) followed by 62.22 and

Table 1: Percent mortality of *T. granarium* caused by different concentrations of three IGRs

IGRs	Conc.	Mean Mortality
Methoxyfenazide	0.03ppm	1.666c
Tebufenazide	0.03ppm	1.666c
Pyriproxifen	0.03ppm	2.916bc
Tebufenazide	0.06 ppm	2.916bc
Methoxyfenazide	0.06 ppm	2.916 bc
Tebufenazide	0.09 ppm	3.333bc
Pyriproxifen	0.06 ppm	4.166abc
Methoxyfenazide	0.09 ppm	5.833 ab
Pyriproxifen	0.09 ppm	7.083 a

Table 2: Larval weight of *Trogoderma granarium* under different concentrations of Pyriproxifen, Methoxyfenazide and Tebufenazide

IGR	Average larval weight(gm)		% Reduction over control
	Mean values	Control	
Pyriproxifen	4.27	6.325	32.49
Methoxyfenazide	4.73	6.74	29.82
Tebufenazide	2.607	3.543	26.40

Table 3: Pupal reduction of *T. granarium* caused by different concentrations of Pyriproxifen, Methoxyfenazide and Tebufenazide

IGR	Average Pupation		% Reduction over control
	Mean values	Control	
Pyriproxifen	5.34	21.52	75.26
Methoxyfenazide	5.92	18.05	67.17
Tebufenazide	6.64	18.05	63.22

Table 4: Population reduction of *T. granarium* against different concentrations of three IGRs

IGRs	Conc.	Mean Mortality
Tebufenazide	0.03ppm	39.882d
Methoxyfenazide	0.03ppm	46.651cd
Methoxyfenazide	0.06ppm	51.231 bcd
Tebufenazide	0.06 ppm	51.453 bcd
Pyriproxifen	0.03 ppm	56.690 bc
Tebufenazide	0.09 ppm	59.861 bc
Pyriproxifen	0.06 ppm	60.807 bc
Methoxyfenazide	0.09 ppm	62.224 b
Pyriproxifen	0.09 ppm	77.927 a

59.861in Methoxyfenazide and Tebufenazide respectively. Parween *et al.* (2003) described that effect of Triflumuron were observed when only one of the parents was reared on the treated food.

The death of early larvae was maximum when adults were reared on treated food.

The effects were more pronounced when the females were treated. Salokhe *et al.* (2003) reported that flufenoxuron significantly reduced the production of viable eggs by the adults which reduce the overall population. Kostyukovsky *et al.* (2000) reported pyriproxifen was the most effective compound among the four IGRs; a concentration of 0.1ppm could completely inhibit the F_1 adult occurrence of both S- and R- strains of *T. castaneum* and it's LC 90s for controlling *R. dominica* and *S. oryzae* were 0.1 and 1.2 ppm respectively.

Parweeen *et al.* (2001) reported that triflumuron decreased the reproductive patentability of i even in resistant strain by delay in egg laying, decrease oviposition, reduce egg viability and lengthened in incubation period even at low concentrations.

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